

g. Materials available during thin film head fabrication are desirable to minimize complexity.

Criteria for successive sacrificial mask layers include:

a. The successive sacrificial mask layer(s) should be different (or chemically distinct) from the underlying mask layer.

b. The material(s) of the successive sacrificial mask layer(s) should be compatible with plating through the same photoresist mask used to plate the bottom mask layer.

c. The successive sacrificial mask layer(s) should have a compatible plating bath(s) which will not react significantly and spontaneously with the underlying mask layer.

d. Materials having a slow ion milling rate are desirable.

e. A successive sacrificial mask layer having a different color than the underlying mask layer is useful to facilitate end point detection.

f. Materials already available during thin film head fabrication are desirable to minimize complexity.

Using the present invention, a metal or alloy sacrificial mask layer may be used in aligning pole tips of a thin film head. If a multi-layered mask is used, excess mask material may be removed either selectively with a chemical etchant or with a lift off process in which a lower sacrificial mask layer comprising a metal or alloy is selectively, chemically etched away. The lift off process allows the use of sacrificial layers which would normally be difficult to remove without damage to the magnetic head structure.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. For example, metal sacrificial layers such as Sn, Zn, Cd, In, Pd, Os, Rh and Pt. and alloys thereof.

What is claimed is:

1. A method of manufacturing a thin film magnetic head upon a substrate comprising the steps of:

depositing a magnetic bottom pole layer upon the substrate;

depositing a gap material layer upon the magnetic bottom pole layer;

depositing a magnetic upper pole layer upon the gap material layer through a photoresist mask;

electroplating through the same photoresist mask a selectively etchable platable metal sacrificial mask layer upon the magnetic upper pole layer;

depositing a top sacrificial mask layer on the metal sacrificial mask layer;

removing the photoresist mask removing portions of the gap layer and the magnetic bottom pole layer not aligned with the upper pole layer whereby the top sacrificial mask layer and the metal sacrificial mask layer protect a portion of the magnetic upper pole layer, the gap layer and the magnetic bottom pole layer; and

chemically etching the metal sacrificial mask layer with a selective mask layer and lift off the top sacrificial mask layer.

2. The method of claim 1 wherein the step of removing non-aligned portions of the magnetic bottom pole layer comprises ion milling the bottom pole layer.

3. The method of claim 1 wherein the step of depositing the metal sacrificial mask layer comprises depositing copper.

4. The method of claim 1 wherein the step of depositing the metal sacrificial mask layer comprises depositing gold.

5. The method of claim 1 wherein the step of depositing the metal sacrificial mask layer comprises depositing zinc.

6. The method of claim 1 wherein the step of depositing the top sacrificial mask layer comprise the step of depositing a nickel-iron alloy.

7. The method of claim 1 wherein the step of depositing the top sacrificial mask layer comprises depositing a photoresist layer.

8. The method of claim 7 and further including curing the photoresist layer to induce a negative slope.

9. A thin film magnetic head formed by the method of claim 1.

10. A method of manufacturing a thin film magnetic head upon a substrate comprising the steps of:

depositing a magnetic bottom pole layer upon the substrate;

depositing a gap material layer upon the magnetic bottom pole layer;

depositing coil and insulator layers confined to a yoke area upon the gap layer;

electroplating through a photoresist mask a magnetic upper pole layer upon the gap and insulator layers;

electroplating over the magnetic upper pole layer through the same photoresist mask a first sacrificial mask layer comprising a metal, wherein the first sacrificial mask overlies only the top face of the magnetic upper pole; and

removing the photoresist removing portions of the gap layers and the magnetic bottom pole layer not aligned with the upper pole layer whereby the first sacrificial mask layer protects portions of the magnetic upper pole layer and underlying gap and magnetic bottom pole layers.

11. The method of claim 10 including the step of selectively chemically etching the first sacrificial mask layer following the step of removing non-aligned portions.

12. The method of claim 10 wherein the step of electroplating a first sacrificial mask layer comprising metal comprises the step of electroplating a first sacrificial mask layer comprising a metal from the group consisting of Cu, Au, Sn, Zn, Cd, In, Pd, Os, Rh and Pt.

13. The method of claim 10 wherein the step of electroplating a first sacrificial mask layer comprising metal comprises the step of electroplating a first sacrificial mask layer comprising a metal alloy from the group consisting of Cu, Au, Sn, Zn, Cd, In, Pd, Os, Rh and Pt.

14. The method of claim 10 including the steps of electroplating one or more successive sacrificial mask layers through the same photoresist mask over the first sacrificial mask layer.

15. The method of claim 14 wherein the step of removing non-aligned portions comprises ion milling the gap layer and the bottom magnetic pole layer following the step of stripping the photoresist mask.

16. The method of claim 14 wherein the step of electroplating one or more successive sacrificial mask layers comprises the step of plating a metal from the group consisting of Ni-Fe, Cu, Au, Zn, Sn, Cd, In, Pd, Os, Rh and Pt.

17. The method of claim 14 wherein the step of electroplating one or more successive sacrificial mask layers comprises the step of plating a metal alloy group con-

sisting of Ni-Fe. Cu. Au. Zn. Sn. Cd. In, Pd, Os, Rh and Pt.

18. The method of claim 14 wherein the step of electroplating successive sacrificial mask layers comprises depositing a nickel-iron sacrificial mask layer.

19. The method of 14 including the step of successively etching off successive sacrificial mask layers prior to etching off the first sacrificial mask layer following the step of removing non-aligned portions.

20. The method of 14 including the step of lifting off the successive sacrificial mask layers by selectively chemically etching off the first sacrificial mask layer following the step of removing non-aligned portions.

21. The method of claim 14 wherein the step of depositing the successive sacrificial mask layers comprises steps of stripping the photoresist mask, and depositing a top photoresist sacrificial mask layer, and wherein the step of removing non-aligned portions comprises ion milling the bottom pole layer.

22. The method of claim 21 including the step of chemically stripping off the top photoresist sacrificial mask layer following the step of removing non-aligned portions.

23. The method of claim 21 including the step of lifting off the top photoresist sacrificial mask layer by selectively chemically etching off the first sacrificial

mask layer following the step of removing non-aligned portions.

24. The method of claim 14 wherein the step of removing non-aligned portions comprises chemically etching the gap layer.

25. The method of claim 10 wherein the step of removing non-aligned portions comprises chemically etching the gap layer.

26. The method of claim 24 or 25 wherein the step of removing non-aligned portions comprises ion milling the bottom pole layer following chemical etching of the gap layer.

27. The method of claim 26 including the step of selectively chemically etching the first sacrificial layer following the step of ion milling the bottom pole layer.

28. The method of 26 including the step of successively etching off successive sacrificial mask layers prior to etching off the first sacrificial mask layer following the step of removing non-aligned portions.

29. The method of 26 including the step of lifting off the successive sacrificial mask layers by selectively chemically etching off the first sacrificial mask layer following the step of removing non-aligned portions.

30. The method of claim 24 or claim 25 wherein the step of chemically etching the gap layer comprises the step of chemically etching the gap layer with HF-H₂O.

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